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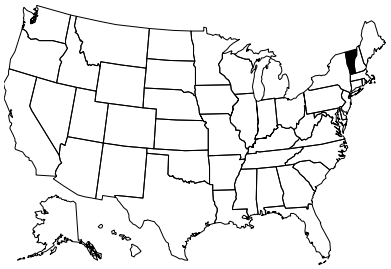

Contact Information

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Program Description

The Water Quality Division of the Vermont Department of Environmental Conservation (VTDEC) has been conducting aquatic biological health assessments since the early 1970's. In 1982, the Biomonitoring and Aquatic Studies Section (BASS) was created with a focus on river and stream biological monitoring. BASS is currently staffed by five full-time aquatic biologists who participate in VTDEC water quality management programs at all levels. This "top to bottom" involvement by biologists has been critical to the extensive acceptance and use of biological assessment data within a wide variety of Departmental programs. The primary objectives of ambient monitoring activities are: 1) monitor long-term trends in water quality as revealed in changes over time to ambient aquatic biological communities; 2) evaluate potential impacts from point and nonpoint permitted direct and indirect discharges, development projects, nonpoint sources, and spills on aquatic biological communities; 3) establish a reference database that would facilitate the generation of Vermont-specific biological criteria for water quality classification and use attainment determinations; 4) support VTDEC permitting and water quality management programs requiring biological assessment data; 5) conduct special studies to assess emerging water quality and environmental management issues. Further information about VTDEC BASS is available at: http://www.anr.state.vt.us/dec/waterq/bass.htm.

Since 1985, the Department has used standardized methods for sampling fish and macroinvertebrate communities, evaluating physical habitat, processing samples, and analyzing and evaluating data. The program has led to the development of two Vermont-specific fish community Indexes of Biotic Integrity (IBI) and selected macroinvertebrate metrics. Guidelines have been developed for determining water quality classification attainment by using both macroinvertebrate community biological integrity metrics and the fish community IBI. Approximately 75-125 sites per year are assessed using fish and/or macroinvertebrate assemblages. Alkalinity, pH, conductivity, temperature and such measurements as substrate composition (pebble counts), embeddedness, canopy cover, percent and type of periphyton cover, and approximate velocity are routinely monitored. From 1985 to 2001, approximately 1,500 stream assessments were completed using macroinvertebrate and/or fish from more than 900 wadeable stream reaches. This monitoring effort is subject to a USEPA-approved quality assurance project plan. Data from the project are summarized and stored in an electronic database.

Biological data are used extensively to determine aquatic life use support and impairment. A significant proportion of Vermont's 303(d) list is made up of reaches with impaired aquatic life use determined through bioassessment. The development of biological criteria supported by the Vermont Water Quality Standards has provided a vehicle for enforceable implementation of biocriteria. Biological assessment data are used extensively in virtually all VTDEC water quality management programs, including RCRA, NPDES, CERCLA, watershed planning, 401 certification, aquatic nuisance control permitting, and 305(b). In addition to wadeable stream monitoring, BASS conducts a variety of special studies and assessment in other aquatic habitats, and is in the process of evaluating biocriteria for vernal pools and ponded waters.

VTDEC participates in collaborations with other agencies and organizations including: USEPA; USFWS; USFS; USGS; academic institutions; neighboring states; private consultants; special interest groups; and volunteer monitors. Staff also participate in public outreach activities as resources allow.

Biological criteria are the current performance standards for a large number of 303(d) waterbodies throughout the state. Future demand for biological assessments from VTDEC management programs will increase as the 303(d)/TMDL process advances and watershed planning initiatives expand statewide. The greatest challenge facing the biomonitoring program will be maintaining adequate staff resources to continue assessing 303(d) restoration management actions, providing support to watershed plan development, and providing support to various management programs within VTDEC and the Agency of Natural Resources.

Documentation and Further Information

Vermont 2000 Water Quality and Assessment, 305(b) Report

Vermont Water Quality Methodology, April 2001

Wadeable Stream Biocriteria Development for Fish and Macroinvertebrate Assemblages in Vermont Streams and Rivers

July 2, 2000 Vermont Water Quality Standards: http://www.state.vt.us/wtrboard/july2000wqs.htm

Fish Sampling and Metrics homepage: http://www.anr.state.vt.us/dec/waterq/bassfish.htm

Macroinvertebrate Sampling, Processing and Metrics homepage: http://www.anr.state.vt.us/dec/waterq/bassmacro.htm

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Programmatic Elements

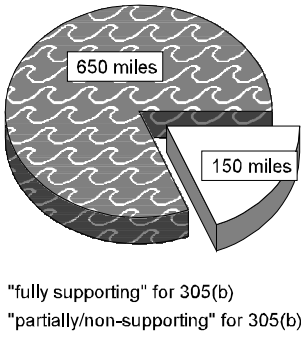
Uses of bioassessment within overall water quality program	✓	problem identification (screening)
	✓	nonpoint source assessments
	✓	monitoring the effectiveness of BMPs
	✓	ALU determinations/ambient monitoring
	✓	promulgated into state water quality standards as biocriteria
	✓	support of antidegradation
	✓	evaluation of discharge permit conditions
	✓	TMDL assessment and monitoring
	✓	other: bioassessments used for all aquatic life use support evaluations
Applicable monitoring designs*	✓	targeted (i.e., sites selected for specific purpose) *(comprehensive use throughout jurisdiction)*
	✓	fixed station (i.e., water quality monitoring stations) *(comprehensive use throughout jurisdiction)*
	✓	probabilistic by stream order/catchment area *(special projects only)*
		probabilistic by ecoregion, or statewide
	✓	rotating basin *(specific river basins or watersheds)*
		other:

*The majority of biological sampling conducted by VTDEC is targeted and in the context of rotating basin elements. Fixed station and special projects are also significant elements. Some monitoring required by discharge permits or basin plans related to TMDL's is done by consultants. Consultants generating biological monitoring data for aquatic life use support determinations consistent with Vermont Water Quality Standards or for compliance with discharge permit limitations are required to meet QA/QC requirements and submit to QA oversight by VTDEC biologists.

Stream Miles

Total miles *(State based determination)*	**7,099**
Total perennial miles	7,099
Total miles assessed for biology*	**~800**
fully supporting for 305(b)	~650
partially/non-supporting for 305(b)	~150
listed for 303(d)	~150
number of sites sampled *(total number with available biological monitoring data)*	1,193
number of miles assessed per site	–

800 Miles Assessed for Biology



*The latest 305(b) report was used to estimate some of these numbers. 305(b) reports total stream miles assessed by "evaluation" and "monitoring". The majority of VTDEC sites that are "monitored" are monitored for biology. The total miles reported as assessed in the last "statewide" assessment report in 2000 was 5,261, with 4,411 miles "evaluated" and 850 miles "monitored". Roughly 800 of the 850 miles "monitored" were monitored using biology (similarly with use support categories).

Aquatic Life Use (ALU) Designations and Decision-Making

ALU designation basis	Class System (A,B,C)	
ALU designations in state water quality standards	Three designations related to changes from reference condition: minimal, minor, and moderate change from the reference condition.	
Narrative Biocriteria in WQS	VTDEC procedures used to support narrative biocriteria are independent of WQS.	
Numeric Biocriteria in WQS	none (Numeric biocriteria are currently found in VTDEC procedural documents.)	
Uses of bioassessment data in integrated assessments with other environmental data (e.g., toxicity testing and chemical specific criteria)	✓	assessment of aquatic resources
	✓	cause and effect determinations
	✓	permitted discharges
	✓	monitoring (e.g., improvements after mitigation)
	✓	watershed based management
Uses of bioassessment/ biocriteria in making management decisions regarding restoration of aquatic resources to a designated ALU	Used extensively throughout management programs including: NPDES, 305(b), 303(d), basin planning, point and nonpoint source management, aquatic nuisance control, RCRA, CERCLA.	

Reference Site/Condition Development

Number of reference sites	**150 total**	
Reference site determinations	✓	site-specific
		paired watersheds
	✓	regional (aggregate of sites)
	✓	professional judgment
		other:
Reference site criteria	Reference sites are defined using the best professional judgment of biologists based on the level of human activity and potential for that activity to affect the aquatic resource. There are no quantitative criteria, but general considerations may include: very good riparian condition at site; predominantly forested watershed; outside the influence of assessed activity; least disturbed condition.	
Characterization of reference sites within a regional context	✓	historical conditions
		least disturbed sites
		gradient response
	✓	professional judgment
	✓	other: minimally disturbed*
Stream stratification within regional reference conditions		ecoregions (or some aggregate)
		elevation
	✓	stream type
	✓	multivariate grouping
		jurisdictional (i.e., statewide)
		other:
Additional information	✓	reference sites linked to ALU
	✓	reference sites/condition referenced in water quality standards
		some reference sites represent acceptable human-induced conditions

*This language is included in the definition of reference condition in the Vermont Water Quality Standards, effective July 2, 2000.

Field and Lab Methods

Assemblages assessed	✓	benthos *(100-500 samples/year; single season, multiple sites - broad coverage)*
	✓	fish *(<100 samples/year; single season, multiple sites - broad coverage)*
	✓	periphyton *(Periphyton and algae in rivers and streams are sampled qualitatively for descriptive purposes only. Some indirect discharge permits require quantitative periphyton and macroinvertebrate sampling with artificial substrates in order to determine compliance with permit conditions. Compliance criteria are independent of WQS.)*
Benthos		
sampling gear		rock baskets, kick net (18x9 rectangular net, 500 micron mesh)
habitat selection		riffle/run (cobble) and woody debris (varies according to stream category)
subsample size		must be minimum 300 animals AND 25% of sample.
taxonomy		lowest possible taxon - genus, species and combination (specified level in SOPs and C185)
Fish		
sampling gear		backpack electrofisher
habitat selection		multihabitat
sample processing		length measurement and anomalies
subsample		none
taxonomy		species
Habitat assessments		visual based and hydrogeomorphology - performed with and independent of bioassessments; pebble counts currently implemented quite extensively in conjunction with bioassessments
Quality assurance program elements		standard operating procedures; quality assurance plan; periodic meetings and training for biologists; sorting and taxonomic proficiency checks; specimen archival; sending voucher specimens to experts for identification confirmation

Data Analysis and Interpretation

Data analysis tools and methods	✓	summary tables, illustrative graphs
	✓	parametric ANOVAs
	✓	multivariate analysis
	✓	biological metrics *(aggregate metrics into an index and return single metrics - use endpoint for each single metric)*
		disturbance gradients
		other:
Multimetric thresholds*		
transforming metrics into unitless scores		Combination of reference distribution, impaired site distribution, and best professional judgement; do not use unitless scores.
defining impairment in a multimetric index		Cumulative distribution function
Multivariate thresholds*		
defining impairment in a multivariate index		Significant departure from mean of reference population
Evaluation of performance characteristics	✓	repeat sampling *(long term fixed station sampling)*
	✓	precision *(field replication)*
		sensitivity
		bias
	✓	accuracy *(sample processing and analysis QA)*
Biological data		
Storage		Data are stored and managed in MS Access data base. Various programs used to analyze sub-sets include: Excel, Sigma-Plot/Stat and PC-ORD
Retrieval and analysis		MS Access database calculates metrics and generates event summary reports. Data can be moved from Access to other programs for project-specific analyses. Commonly used programs include: Excel, Sigma-Plot/Stat, PC-ORD

*Benthos data are used to generate individual metrics, which are considered individually. Fish assemblage data are used to generate metrics for a multimetric Index of Biotic Integrity. Water Quality Standard thresholds (deviations from the reference condition) are based on BPJ evaluations of metric distribution patterns in both reference and non-reference sites.